

REMARKS

The Examiner is thanked for the thorough examination of the above-referenced application. Claims 19, 34 and 42 have been amended. Claims 1-18, 26 have been canceled. Claims 19-25, and 27-42 remain in this application. Based on the amendments, Applicants respectfully submit that the rejections are moot. However, to advance the prosecution of this matter, Applicants will point out distinguishing features below.

Independent claims 19, 34, and 42

As amended, independent claims 19, 34, and 42 recite:

19. A metal structure, comprising:
a semiconductor substrate with a conductor thereon;
an insulating layer overlying the semiconductor substrate having a hole therein exposing the conductor, *wherein the insulating layer comprises USG*;
a conductive plug substantially filling the hole and electrically connecting the underlying conductor, *wherein the conductive plug comprises tungsten*;
a *carbon-doped silicon oxide* or carbon and nitrogen-doped silicon oxide, serving as an adhesion layer, overlying the insulating layer and the conductive plug;
a low dielectric constant layer overlying the *carbon-doped silicon oxide* or carbon and nitrogen-doped silicon oxide;
a trench in the low dielectric constant layer and the *carbon-doped silicon oxide* or carbon and nitrogen-doped silicon oxide; and
a copper or copper alloy conductor substantially filling the trench, electrically connecting the conductive plug.

34. A metal structure, comprising:
a semiconductor substrate with a conductor comprising nickel silicide thereon;
an insulating layer overlying the semiconductor substrate having a hole therein exposing the conductor, *wherein the insulating layer comprises USG*;
a conductive plug substantially filling the hole and electrically connecting the underlying conductor, *wherein the conductive plug comprises tungsten*;
a carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide, serving as an *adhesion* layer, overlying the insulating layer and the conductive plug;

- a low dielectric constant layer overlying the carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide;
- a trench in the low dielectric constant layer and the carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide;
- a diffusion layer lining the trench; and
- a copper or copper alloy conductor substantially filling the trench, electrically connecting the conductive plug.

42. A metal structure, comprising:

- a semiconductor substrate with a conductor thereon;
- an insulating layer overlying the semiconductor substrate having a hole therein exposing the conductor, *wherein the insulating layer comprises USG*;
- a conductive plug substantially filling the hole and electrically connecting the underlying conductor, *wherein the conductive plug comprises tungsten*;
- a *carbon-doped silicon oxide* or carbon and nitrogen-doped silicon oxide, serving as an *adhesion* layer, overlying the insulating layer and the conductive plug;
- a low dielectric constant layer overlying the *carbon-doped silicon oxide* or carbon and nitrogen-doped silicon oxide;
- a trench in the low dielectric constant layer and the *carbon-doped silicon oxide* or carbon and nitrogen-doped silicon oxide;
- a diffusion layer lining the trench; and
- a copper or copper alloy conductor substantially filling the trench, electrically connecting the conductive plug.

(*Emphasis added.*) These claims patently define over the cited art for at least the reason that the cited art fails to disclose at least those features emphasized above.

Discussion of Rejections under 35 U.S.C. 103(a)

Claims 19, 20, 22-25, 28-30, 33, and 42 are rejected under 35 U.S.C. 103(a) as allegedly unpatentable over US published application 2004/0077181 to Choo et al in view of US 6,660,627 to Hu et al.

Claims 21, 31-32, 34-41 are rejected under 35 U.S.C. 103(a) as allegedly unpatentable over US published application 2004/0077181 to Choo et al in view of US 6566701 to Agarwal.

Claims 19, 34 and 42

Applicants respectfully submit that the Office Action has failed to show that Choo, Hu or Agarwal (alone or in combination) discloses or suggests the embodiments that are expressly recited in claims 19, 34, and 42. Specifically, features defining these claims include *"an insulating layer overlying the semiconductor substrate having a hole therein exposing the conductor, wherein the insulating layer comprises USG", "a conductive plug substantially filling the hole and electrically connecting the underlying conductor, wherein the conductive plug comprises tungsten", "a carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide, serving as an adhesion layer, overlying the insulating layer and the conductive plug", "a low dielectric constant layer overlying the carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide", and "a trench in the low dielectric constant layer and the carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide"*.

In this regard, Applicants submit that the neither of Choo, or/and Hu or/and Agarwal disclose or reasonably suggest the embodiments defined in claims 19, 34 and 42. Applicants therefore respectfully submit that claims 19 and 42 are patentable over Choo in view of Hu, and that claim 34 is patentable over Choo in view of Agarwal.

Further, the amended claim 19, 34 and 42 disclose a combination of two independent single damascence structures, i.e. an ILD underlying the adhesion layer and an IMD over the adhesion layer. The ILD comprises a regular-k insulating layer of USG, and the IMD comprises a low-k dielectric. The adhesion layer, made of a carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide, provides better adhesion/glue capability than SiC. The carbon-doped silicon oxide or carbon and nitrogen-doped silicon oxide has a relatively low k-value than

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SiC. However, Choo, Hu or Agarwal discloses a dual damascene, not a combination of two independent single damascene structures.

Under MPEP 2143, to establish a prima facie case of obviousness, the prior art reference, or references when combined, must teach or suggest all the claim limitations. Since the cited references do not teach the above-quoted limitations of the amended claims 19, 34 and 42, the Applicants respectfully submit that amended claims 19, 34, and 42 should be allowed. Claims 20-25, 27-33, and 35-41 should also be allowed, at least by virtue of their dependency from the amended claims 19 and 34, respectively.

As a separate and independent basis for the patentability of the claims, Applicants respectfully traverse the rejections as failing to identify a proper basis for combining the cited references. In combining these references, the Office Action stated only that the combination of Choo with Hu would have been obvious "because such etch stop material is conventional in the art and the etch stop material is being selected according to its etch selectivity." (Office Action, page 4, lines 1-3). Likewise, the Office Action stated only that the combination of Agarwal with Choo would have been obvious "because either Cu, W or metal silicide can be used as a conductor material." (Office Action, p. 5). These alleged motivations are clearly improper in view of well-established Federal Circuit precedent.

It is well-settled law that in order to properly support an obviousness rejection under 35 U.S.C. § 103, there must have been some teaching in the prior art to suggest to one skilled in the art that the claimed invention would have been obvious. W. L. Gore & Associates, Inc. v. Garlock Thomas, Inc., 721 F.2d 1540, 1551 (Fed. Cir. 1983). More significantly,

"The consistent criteria for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that this [invention] should be carried out and would have a reasonable likelihood of success, viewed in light of the prior art. ..." Both the suggestion and the expectation of success must be founded in the prior art, not in the applicant's disclosure... In determining whether such a suggestion can fairly be gleaned from the prior art, the full field of the invention must be considered; for the person of ordinary skill in the art is charged with knowledge of the entire body of technological literature, including that which might lead away from the claimed invention."

(*Emphasis added.*) In re Dow Chemical Company, 837 F.2d 469, 473 (Fed. Cir. 1988).

In this regard, Applicants note that there must not only be a suggestion to combine the functional or operational aspects of the combined references, but that the Federal Circuit also requires the prior art to suggest both the combination of elements and the structure resulting from the combination. Stiftung v. Renishaw PLC, 945 Fed.2d 1173 (Fed. Cir. 1991). Therefore, in order to sustain an obviousness rejection based upon a combination of any two or more prior art references, the prior art must properly suggest the desirability of combining the particular elements to derive a Tungsten-Copper Interconnect, as claimed by the Applicants.

When an obviousness determination is based on multiple prior art references, there must be a showing of some "teaching, suggestion, or reason" to combine the references. Gambro Lundia AB v. Baxter Healthcare Corp., 110 F.3d 1573, 1579, 42 USPQ2d 1378, 1383 (Fed. Cir. 1997) (also noting that the "absence of such a suggestion to combine is dispositive in an obviousness determination").

Evidence of a suggestion, teaching, or motivation to combine prior art references may flow, inter alia, from the references themselves, the knowledge of one of ordinary skill in the art, or from the nature of the problem to be solved. See In re Dembiczak, 175 F.3d 994, 1000, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999). Although a reference need not expressly teach that the disclosure contained therein should be combined with another, the showing of combinability, in

whatever form, must nevertheless be "clear and particular." Dembiczak, 175 F.3d at 999, 50 USPQ2d at 1617.

If there was no motivation or suggestion to combine selective teachings from multiple prior art references, one of ordinary skill in the art would not have viewed the present invention as obvious. See In re Dance, 160 F.3d 1339, 1343, 48 USPQ2d 1635, 1637 (Fed. Cir. 1998); Gambro Lundia AB, 110 F.3d at 1579, 42 USPQ2d at 1383 ("The absence of such a suggestion to combine is dispositive in an obviousness determination.").

Significantly, where there is no apparent disadvantage present in a particular prior art reference, then generally there can be no motivation to combine the teaching of another reference with the particular prior art reference. Winner Int'l Royalty Corp. v. Wang, No 98-1553 (Fed. Cir. January 27, 2000).

For at least the additional reason that the Office Action failed to identify proper motivations or suggestions for combining the various references to properly support the rejections under 35 U.S.C. § 103, those rejections should be withdrawn.

CONCLUSION

In light of the foregoing amendments and for at least the reasons set forth above, Applicant respectfully submits that all objections and/or rejections have been traversed, rendered moot, and/or accommodated, and that the now pending claims are in condition for allowance. Favorable reconsideration and allowance of the present application and all pending claims are hereby courteously requested. If, in the opinion of the Examiner, a telephonic conference would expedite the examination of this matter, the Examiner is invited to call the undersigned attorney at (770) 933-9500.

No fee is believed to be due in connection with this amendment and response to Office Action. If, however, any fee is believed to be due, you are hereby authorized to charge any such fee to deposit account No. 20-0778.

Respectfully submitted,


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